

End-to-End View of a Data System for the Living With a Star (LWS) Program

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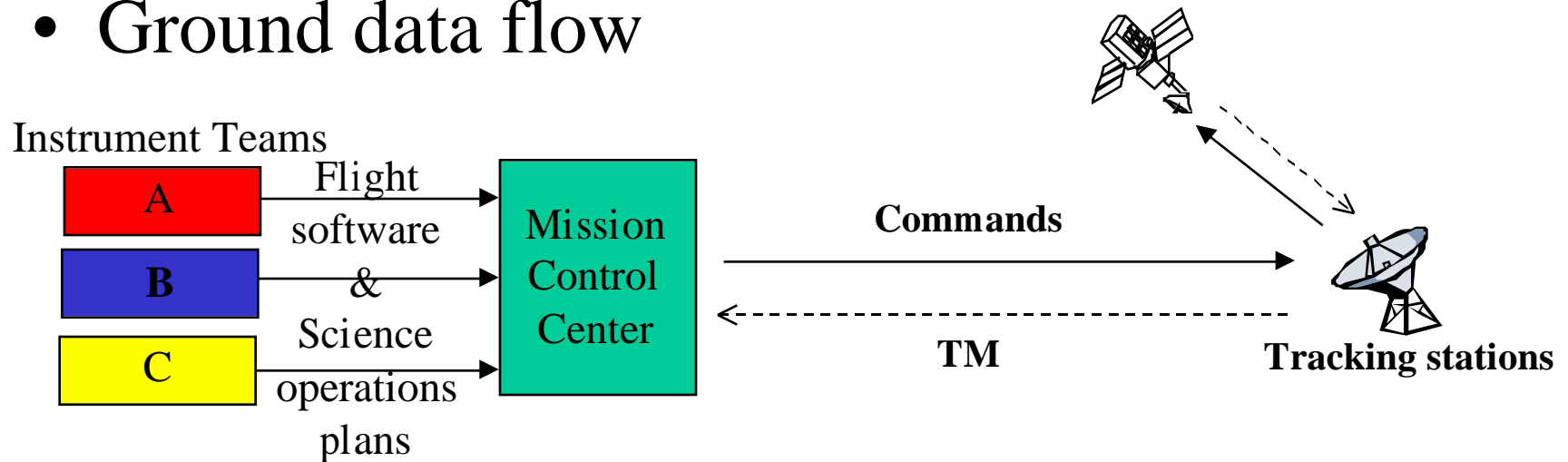
LWS Science Architecture Team (SAT)

Finding, issued 8/1/01

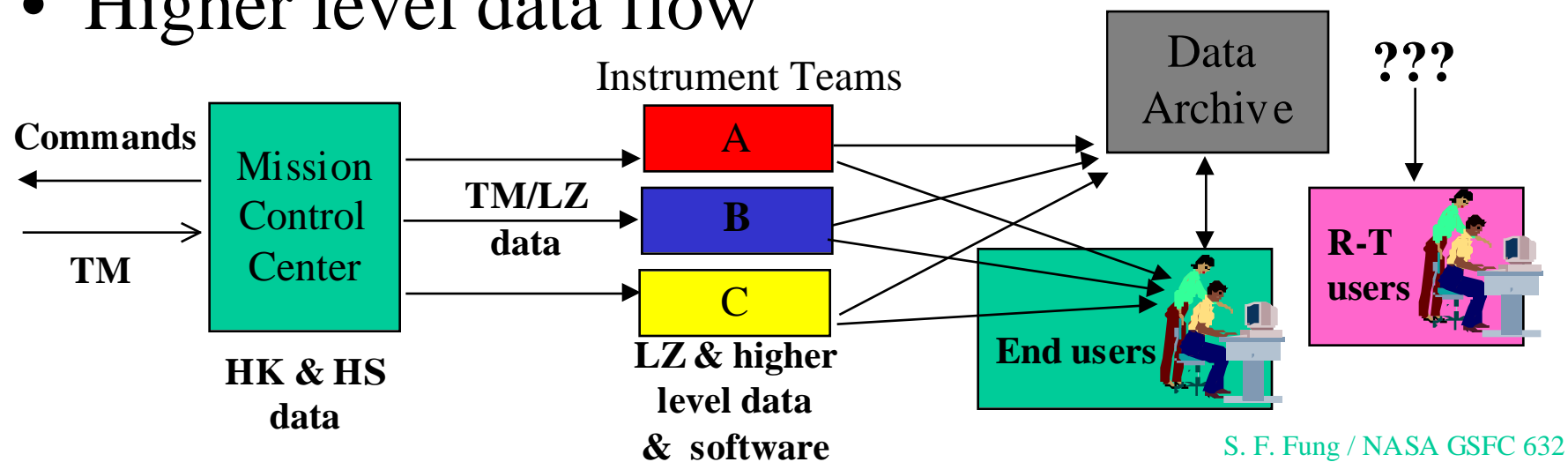
- LWS Comprehensive Data System Management
 - Create data system to support:
 - Easy access to multiple data sets for
 - developing, refining, and testing theory
 - modeling of Sun-Earth system
 - Cost effective acquisition (and management) of NASA, non-NASA (space-based & ground-based) data required to carry out theory and modeling
 - Build on existing ISTP archives
 - Partnering with other agencies to ensure availability of non-NASA mission data
 - Increase scientific productivity of existing NASA assets
 - Form a Data Systems Team (DST)

Mission Data Flows

- Ground data flow



- Higher level data flow



Traditional vs. End-to-End View of a Mission Data System

Traditional View

- Ground system (GS) and higher-level data system (HLDS) are viewed as separate systems
- Developed and implemented independently
 - Independent cost drivers
 - Little or no cost-sharing
 - Separate operators and maintenance
 - no sharing of functional support
 - Separate system for trend analysis
 - ‘Reactive’ interface between GS and HLDS
 - GS can be expensive to operate for cost-capped missions
 - Data stored at multiple sites
 - mission ops center for health & safety, and trend analysis
 - Science/instrument teams for processing and distribution

‘End-to-End’ View

- GS and HLDS operates as ‘one system’ via a **single facility: SMOC**
 - Science processing and monitoring by same ‘FOT’
 - reducing staff and backups required for each separate facility.
 - No duplications in system maintenance and security
 - Effective use of hardware
 - low maintenance
 - Use of science data products to monitor the health/operation of the spacecraft
 - e.g., IMAGE uses science and housekeeping CDFs and *CDAWeb* for trend analysis
 - Eliminated duplications in data handling and storage facilities, simplifying:
 - GS design, testing and implementation;
 - data flow within data system
- Allow systems engineering approach to science and mission operations, such as
 - **Autonomous spacecraft operations**
 - **Enabling ‘lights-out’ GS operations**
 - **Minimizing external interface (low-maintenance)**
 - **Real-time data streaming**
 - **Increasing cost/staff efficiency**

End-to-End View of Mission Data Flows (a la IMAGE SMOC Model)

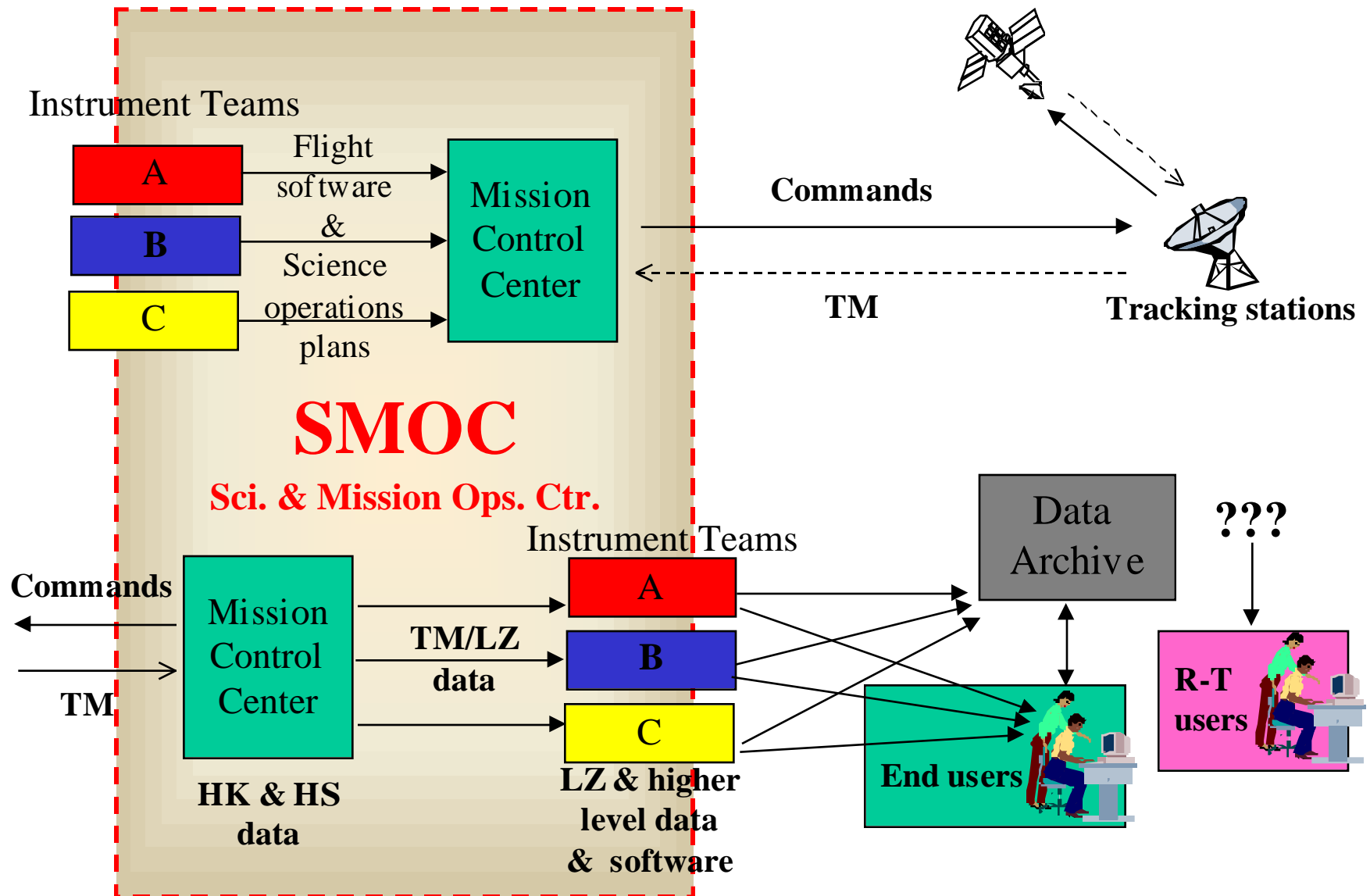
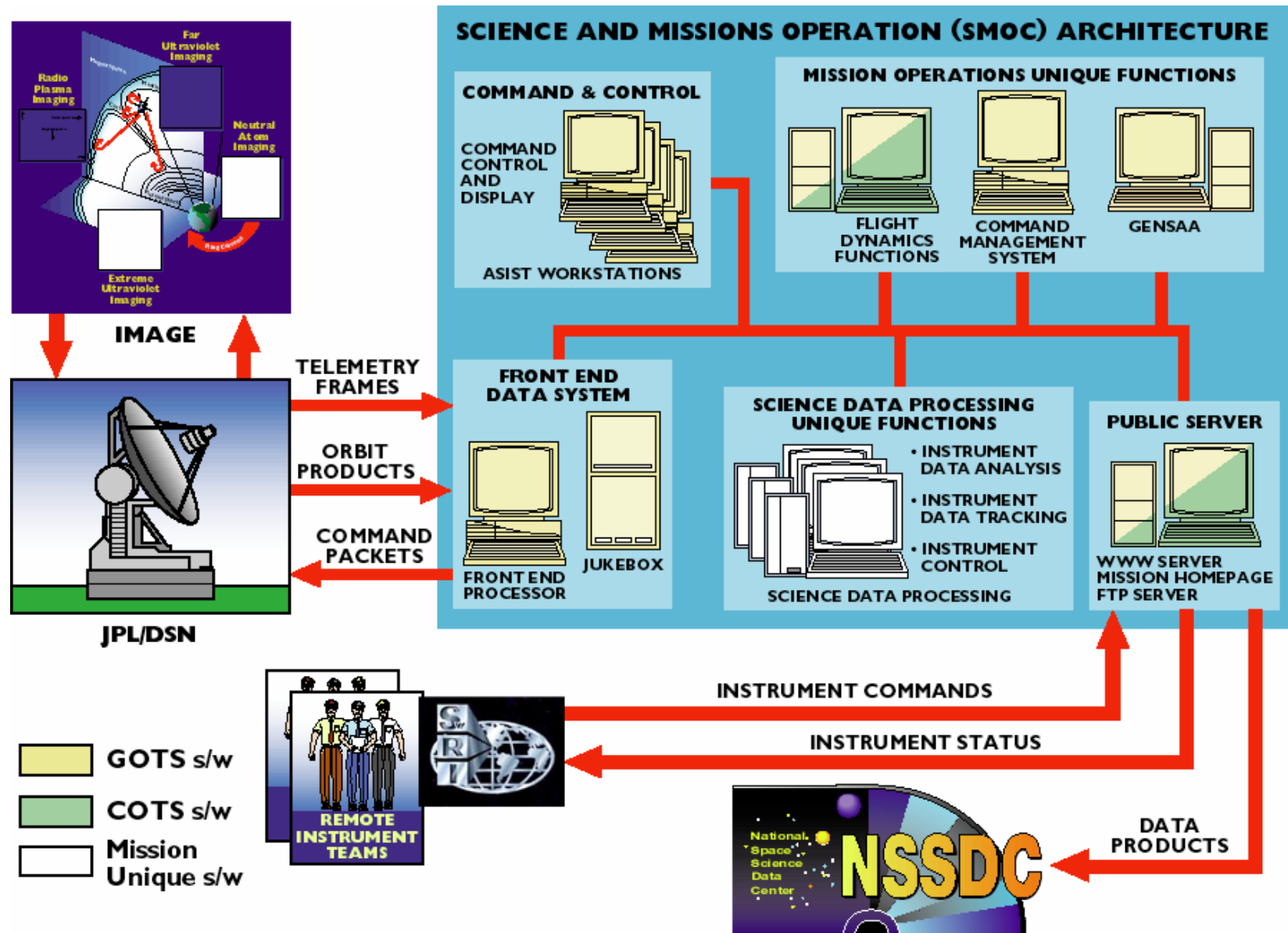


IMAGE SMOC Architecture

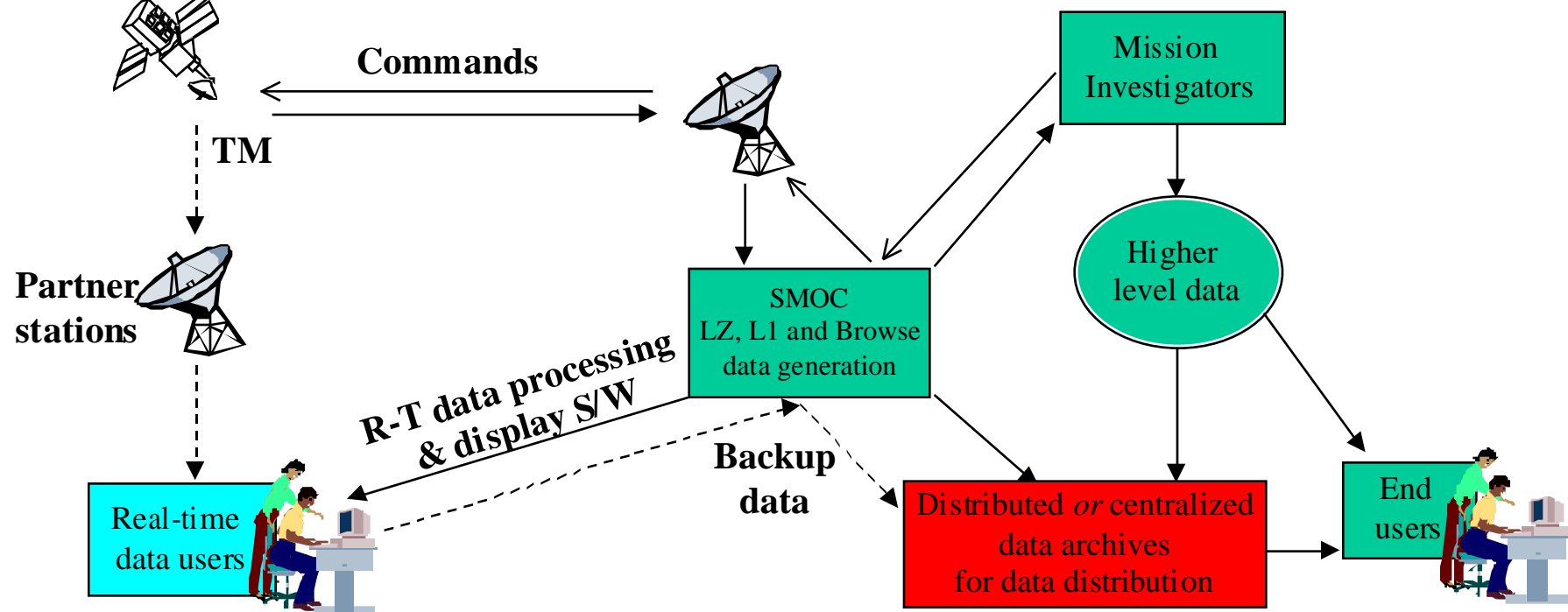


[from Burley et al., 2000]

So, What About a LWS Data System?

- What are the functional requirements of a LWS data system?
 - Receives telemetry
 - Uploads/updates spacecraft commands and flight software
 - Processes & delivers LZ and browse data to LWS investigators and data archives
 - Supports diverse user community
 - All LWS Project elements
 - Missions (SDO, Sentinels, RBM, IM), Th&M, and SE Testbeds
 - End users & real-time data users

End-to-End Mission Data Flow



So, What About a LWS Data System?

- Who are the users?

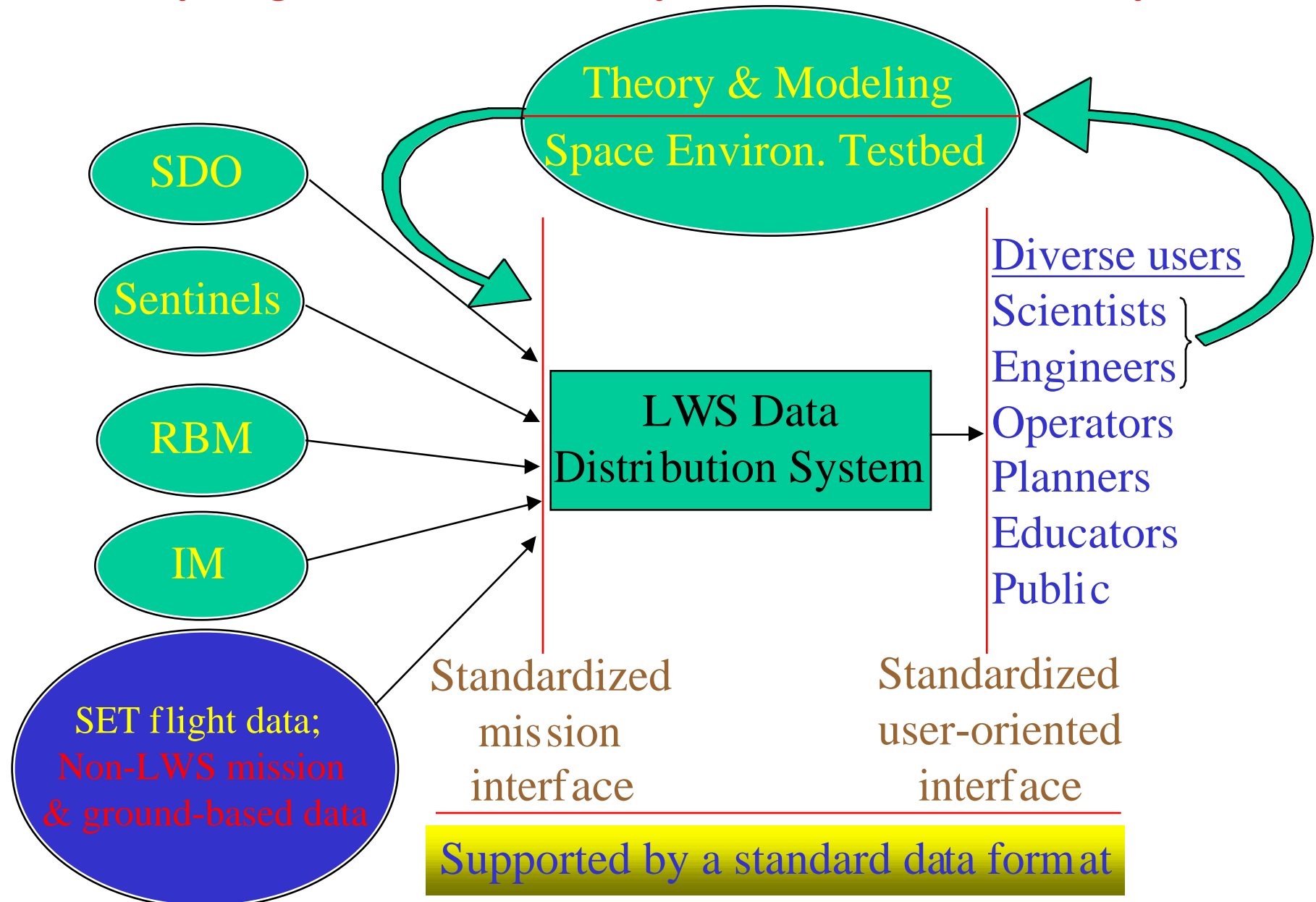
...cont.

- Scientists (both researchers and modelers), space mission planners and engineers, s/c operators, educators, public, policy makers, and
- **eventually**, space weather forecasters

- What the LWS data system has to do?

- Must provide **end-to-end support** to all LWS elements
- Must support **multi-discipline** users
 - Science, engineering (operations, SE testbed), planning, forecasting)
 - Friendly, but **user-specific** interface
- Must be **flexible** and **functional**
 - Use **standard** interfaces and data format
 - Benchmark data processing algorithms and flight software
 - Development and testing
 - **Maintenance & configuration control**
 - Handling **large data volume** [real-time (e.g., SDO) and retrospective]
 - Allow **tailoring & adding** services and deliverables to facilitate
 - theory and model development
 - Evolving needs for space weather forecasting

Unifying Functionality of LWS Data System



Two Paradigms for HLDS

- Mission-dedicated system
 - Independent for each mission
 - Distributed system possible
 - Data integration is done by users
 - More work by users
 - Customization possible
 - System may have “short-life”
 - “cheaper” to build for single, cost-capped mission
- Integrated data system
 - Redundancy are optimized
 - Mirror sites as “distributed” system
 - e.g., *CDAWeb*
 - *Standardized* data format and interfaces
 - Not mission-centered
 - Coordinated science supported
 - Requires long-range planning
 - System re-use is part of planning
 - Easier to develop, extend (new functionality and services), and maintain
 - Adaptable to evolving technology

LWS data system may be a **hybrid** of the two

Recalling *LWS SAT* Finding

8/1/01

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Conclusions

- The LWS Data System serves the whole LWS Program and beyond
 - should be a **mission-level element**
- The LWS Data System “**glues**” all program elements together
 - serves multiple elements as a whole, not just individual missions
 - diverse user communities (different requirements)
- Streamline operations **to reduce redundancy and contain overall cost**
 - **Build on** existing *ISTP* capabilities (e.g., *CDAWeb* and *SSCWeb*)
 - **SMOC** (e.g., IMAGE, MAP)
- Key to success is **careful planning**
 - Consider **end-to-end data system** as a mission-level element of LWS program
 - Understand **user requirements**
 - Determine the **optimal technical approach**
 - Enforce **PDMP**
 - Assigning PI roles in *producing, sharing and archiving* all LWS data products
 - Allocate **sustained resources**
 - Ensuring continued *availability* and *accessibility* to all LWS data products
- LWS community support required